

JOURNAL

OF THE

New York Entomological Society

VOL. XXXVI

DECEMBER, 1928

No. 4

VARIATION IN JUNONIA LAVINIA (LEPIDOPTERA, NYMPHALIDÆ)

BY WM. T. M. FORBES

CORNELL UNIVERSITY, ITHACA, NEW YORK

The Buckeye, *Junonia* or *Precis lavinia*, with its forms, is the most striking case of geographical variation in the whole American butterfly-fauna, on account of its wide distribution and the number and brilliancy of its forms. The present account is far from complete, but will outline the situation and call attention to the places where further study is needed.

For this protean species, *lavinia* Cramer seems to be the oldest name. It was based on a specimen from Surinam, but it happens that Surinam is a meeting place of northern and southern forms, and typical *lavinia* is not typical of any of the well-marked races of the species. I suppose it should be used of one or another of the races, but it happens to be such an exact blend of the principal northern and southern forms that I am not using it as a subspecies name.

Leaving out of account a few local forms of limited distribution, the species as a whole can be divided into three well-marked series of geographical forms, which may be called roughly the North, Central and South American types. The first two of these have a peculiar relation. They meet both in Mexico and in the Greater Antilles. In Mexico they evidently interbreed, and material from northern Mexico (Sinaloa and Durango) is usually intermediate in character, but in Cuba they exist side by

side without blending; apparently two stocks have reached Cuba by different routes (via North and South America) and have become so distinct on the way that from the Cuban point of view they would seem to be real species. In other words, we have here species caught in the very act of formation.

The North American series may be called *J. l. coenia* Hübner. It varies somewhat, locally, but it is not necessary to divide it at present. It may be characterized as follows:

Ground umber brown, even, without green overlay; markings clean-cut, more sharply defined than in any other form; fascia across apex of cell of fore wing broad, white, crossed with fine black veins, but without any tawny or red sealing; with a white crescent before the lower eye-spot, which is narrowly if at all connected with the upper part of the fascia; subapical fork of fascia obsolete. Upper ocellus of hind wing exceptionally large, with some violet sealing on its inner half, *enclosed in a definite red semicircle*. Hind wing beneath variable in tint, usually pale with fine dark lines, rather than bands, the ocelli inconspicuous, not black. In its normal state the red crescent is absolutely distinctive of this form, and is a primitive character, appearing in several old-world species. There is a suffused black form (*nigro-suffusa* B. & McD.) where the white markings are all covered, and the black may occasionally obliterate even the red crescent. In such extreme specimens the form is difficult to separate from the corresponding South American form, but such specimens are very rare. Massachusetts to California, south to Sinaloa and Durango, Mexico, and occasionally even to near Mexico City, but Mexican specimens usually show a tendency to show characters of *zonalis* or *genoveva*; also from Cuba and Isle of Pines. Seasonal dimorphism is moderate, but there seems some variation in the color of the under side.

The second group of forms occupies Central America from Sinaloa and Durango, Mexico, where they intergrade with *coenia*, to Peru and northern Brazil, and also the Antilles. As a whole they are marked by a transverse fascia more or less tinted with tawny or pinkish, but not deep orange, and sometimes reduced to a series of diffuse spots or lost in blackish suffusion. They do not have any metallic green suffusion, or only

faint traces in occasional specimens. This form is strongly dimorphic, and I believe seasonally, though my dates are too incomplete to be quite sure, and the two races of the paler (dry) form do not coincide with those of the dark form. Of this series the most characteristic form is the usual wet phase, *zonalis* Felder (*occidentalis* Fld.?).

Ground gray-brown, just as in form *coenia*, or with a little tawny dusting at the base. Fore wing with a broad and conspicuous white fascia across the apex of the cell, more or less edged and shaded with pinkish tawny, or even suffused with this color (var. *incarnata* Fld.); outer upper fork of fascia tawny, shading into brown at the costa, but well developed and conspicuous; lower end of fascia also well developed and extending practically to anal angle. Upper ocellus well developed, with more or less distinct white spots above it, the first of them often developed into an imperfect ocellus, but no dark dots in the lower interspaces; lower ocellus large, and normally completely surrounded with a tawny ring, which is not narrowed where it joins the main part of the fascia. Hind wing with a narrow tawny submarginal band or none. Fore wing below with the fascia conspicuous and crossing the subterminal lines to the outer margin, the white spot above the upper ocellus almost always ocellate. Hind wing below broadly shaded with red-brown from the postmedial line to beyond the ocelli, and frequently suffused with red-brown. Postmedial line preceded by a straight, narrow pale shade, which is frequently conspicuous. Ocelli always black, and ringed with yellow and black, as on the upper surface, frequently heavily scaled with blue. Frequently with a third large ocellus in cell R.

The typical condition of this form is easily recognized. It is what has commonly passed for *genoveva* (for instance, in Holland's "Butterfly Book," Pl. 20, Fig. 9, and in the "Biologia Centrali-Americana"). The type locality is Colombia. It is also found with some variation widely distributed in Mexico and Central America and in the West Indies, where each island seems to have some peculiarity. It reaches north to Mazatlan, Mexico, where transitions to *coenia* are more common, and to Inagua, Bahamas. Cuban specimens are usually much like mainland

ones, but those from San Domingo, Porto Rico and St. Thomas have very large ocelli. From present knowledge this and the pale form seem curiously divided between the West India Islands—*genoveva* is rare on Jamaica, Porto Rico and St. Thomas, but seems less rare in San Domingo; I have seen only *zonalis* from St. Kitts, Antigua, Guadeloupe and Sta. Lucia, and mainly the form *incarnata* from Dominica. *Zonalis* is relatively rare on Trinidad and appears absent from Barbados. My males from Grenada approach *zonalis*, but the only female is an extreme *genoveva*. From Venezuela I have not seen *zonalis*, though it should occur, and it is replaced by variant forms in the Guianas. *Zonalis* was included in Felder's original conception of *occidentalis*, but I have preferred to use a well founded name to a confused and doubtful one.

J. l. oriana Kby., the usual wet form in British and Dutch Guiana, is close to *zonalis*, differing only in having a narrower pale fascia across the fore wing. I have such specimens from Kartabo, British Guiana, and from Paramaribo, Surinam. One or two of my specimens show traces of green iridescence, and the original figure of *lavinia* shows fully developed iridescence, but has the pattern of this form, which perhaps should not be separated from *l. lavinia*. I have a single such specimen from Curaçao.

Form *evarete* Cr. This is similar to *zonalis*, but the under side is deep umber brown without eyespots, evidently approaching form *constricta*. I have such specimens with transitions to the preceding, taken at Paramaribo just at the change from dry to wet season, and a dwarf from Margarita Island.

This completes the list of wet forms from the central zone, except for a form of limited distribution in British Guiana, which I will discuss along with the sand-barrens forms. The following appear to be the corresponding dry forms.

J. l. basifusca Weymer.—This is obviously a development of *zonalis*, which, so far as we know, is confined to western Ecuador. It is distinguished by the combination of conspicuous light yellow outer markings and obsolescent blackish bars in the cell. So far as known to me in all other forms not wholly suffused with blackish, the bars in the cell are conspicuous. It may pos-

sibly intergrade with *constricta* in southwestern Colombia, from which I have not seen material.

J. l. z. form *constricta* Felder. Similar to *zonalis*, but with the upper inner fork of the fascia very narrow, hardly if at all wider than the ring surrounding the eyespot, and with the outer fork obscure, giving a certain resemblance to the Australian species *vellida*. Under side reddish brown, powdery, with eyespots obscure or absent.

In its typical condition this is a rather distinct form, and usually contrasts well with *zonalis* specimens from the same region. It connects rather with some of the Guiana strains, *arenosa* and *evarete*, though instantly distinguishable except from the large aberrant specimens of *arenosa*, and they are much less brilliantly colored. Its distribution is curious; primarily Colombia and Cuba, in both of which places it associates with *zonalis* forms with small eyespots. I have seen it (not typical) from Yurimaguas, in northern Peru, and from Panama and Jamaica (where *zonalis* seems to be the only normal form). *Zonalis* in the rest of its area either exists alone, so far as we know, or is associated with a form that has a close resemblance to the Surinam *genoveva*.

P. l. l. form *genoveva* Cramer. Upper side pale, the wings longer than in typical *lavinia*, at least in mainland males. Under side typically straw color, with the markings mainly of fine and waved transverse lines; eyespots obsolete below.

This form, or perhaps rather group of forms, is distinguished from other central forms mainly by its general pale color and by its lack of green from *negra*, etc. The female is sometimes very pale, with the general ground really tawny, and occasionally shows the discal spot of the hind wing as in the old-world species, but usually only as a fine outline. Island specimens tend to be shorter-winged, especially females, and I thought at one time that the palest island forms might be separated, but wherever I have series, individual variation is so large as to make it unsafe. In the Antilles *genoveva* occurs erratically to judge by present knowledge: Hayti, San Domingo, Jamaica (rare), Porto Rico and St. Thomas (rare), Trinidad. On Barbados it seems to be the only form, but wet-season specimens average darker.

Dry females are a decided tawny yellow, and standing by themselves would be taken for a distinct species approaching *vestina*. It also was taken in the wet season at Grenada, so there also it is likely to be the only form. On the mainland it is the dry form at Paramaribo, and I have seen it from Venezuela and Honduras, though in intermediate country *constricta* seems to replace it.

In the Guianas there is a series of belts of barren and generally sandy savanna extending roughly east and west. These zones have been sampled entomologically at Zanderij, Surinam, and on the Potaro in British Guiana, from Kaieteur well toward Roraima. They seem to be occupied by a special series of *lavinia* forms of striking character; one the smallest of all the forms, one the blackest (aside from single aberrant specimens of *coenia*) and the third with the most extensively developed bright tawny areas. The first of these is evidently a dry form, with an upper side approaching *constricta* and the under side of *genoveva*, and the third is obviously a wet form with the color scheme of *zonalis incarnata*, or *hubneri* (except the lack of green). It is not clear to which form the black one is attached, but the under side and female seem nearest *zonalis*. We may name these three forms *arenosa*, *nigralis* and *vivida*.

J. l. arenosa new race.

Expanse typically 33-40 mm. (aberrant specimens up to 48 mm.). Upper side olivaceous brown, about the color of male *genoveva*, with the area between and beyond the tawny bars in the cell perceptibly paler, and a well-marked dark postmedial band, angled out on veins M_2 and M_3 , and concave above and below. Bars in cell bright tawny, fascia of a narrow cross-band at the end of the cell not more than twice as wide as an interspace and a pale circle around the large lower eye-spot of about the same width, both crossed by dark shades on the veins. A dark crescent below the eye-spot as usual, and a dark shade-line connecting the two eye-spots and running up from the upper toward the costa, where it is lost in dark ground. Before this last line is a distinct double, whitish costal spot, and beyond it and continued outside the upper eye-spot to connect with the band encircling the lower eye-spot is a somewhat darker band, not usually distinct above R_5 . Border dark, as usual with broken pale filling. Hind wing similar, usually without traces of a discal bar, with a continuous submarginal band tangent to the outer sides of the eye-spots. Border of a triple dark line, enclosing two pale lines, the outer obscure. Light markings straw color in male, in

the female more or less suffused with tawny, especially the portions beyond the ocelli and the band on the hind wing. Under side essentially as in *genoveva*: straw color, the hind wing with wavy and somewhat diffuse darker transverse lines. Cell of fore wing largely filled with three large tawny, dark-outlined patches, the spaces between them pale straw color, and with some tawny below cell, especially in the female. Upper eye-spot of fore wing minute, lower large and conspicuous, hind wing usually with two well-marked and fully formed eye-spots. Postmedial band as above, usually blackish and strongly contrasting, a blackish subterminal band cut with pale veins, from M_2 to inner margin, and less strongly on whole width of hind wing. Hind wing frequently with a transverse red-brown shade before eye-spots, and both wings typically with black points between eye-spots.

Zandarij, Boven Para District, Surinam, abundant on the sand-barrens (mingled with a small proportion of aberrant forms) in April. Also in American Museum of Natural History from Kaieteur, Potaro River, British Guiana, July 20 and August 8, the latter specimens larger than any but two of the Zandarij ones. Cornell University, type no. 889.

J. l. vivida new variety.

Expanse 40–50 mm., larger than typical *arenosa*, though hardly larger than specimens from the same region. Ground deeper, nearly as dark as normal in form *zonalis*; bands as in *arenosa*, but better developed, especially the band across beyond the apex of the cell; and all deep bright tawny (cinnamon rufous of Ridgway) averaging not quite as dark as *hubneri* but richer than in *zonalis*, even in fully colored incarnata forms. Spots above upper eye-spot white, as usual. Inner line in the dark border yellowish, about as in *arenosa* and decidedly paler than the tawny markings, the outer line suffused but traceable on fore as well as hind wing. Under side of the *zonalis* type, but much paler than in normal *zonalis*, the ground yellowish but strongly shaded and banded with brown, forming a broad band before the eye-spots of the hind wing, with a straight pale band before it and a decidedly tawny subterminal band beyond. Fore wing strongly shaded with tawny, especially about the upper eye-spot.

Irong River to Roraima, British Guiana. Aug. 6–14, 1911. Type no. 890. Types in American Museum of Natural History; paratypes in C. U.

This is likely to be the wet form of *arenosa*. Besides the type series I have a slightly aberrant specimen from Republick, Surinam, Mar. 28. This specimen is much darker beneath, approaching oriana, and closely matches some specimens from the Uaupes

River on the edge of Colombia. *Vivida* is really intermediate between *arenosa*, *zonalis* and *hubneri*, the large area of tawny on the hind wing also commonly occurring in *hubneri*, though generally of a deeper tint.

J. l. nigralis new aberration.

Smoky black, the tawny bars in the cell only faintly paler, and outlined with deep black, the eye-spots and marginal markings also traceable, and the usual yellow ring about the eye-spots of the hind wing most distinct. Under side black-brown, the usually tawny bars in and about the cell represented in mahogany brown, the eye-spots rather well marked and normal, and the deeper chocolate brown transverse fascia of the hind wing rather easily traced, suggesting *zonalis*. Female also blackish, but with all the markings rather distinctly traceable, the fascia as in *arenosa*, but dirty brown and less extensive, the band across beyond the cell, of separate palish spots as a rule. Under side of fore wing with medial area heavily shaded with brown, leaving a contrasting pale angulate postmedial line beyond the usual blackish one, which is inconspicuous. Hind wing largely dark brown, but with a blackish band through the three eye-spots and a red-brown band before it, preceded by a pale postmedian band; subterminal region also pale, crossed by a wavy dark line.

Kaieteur, British Guiana, with the larger phase of *arenosa* and tending to intergrade with it. Type no. 891. Types in American Museum of Natural History; paratypes in C. U.

This may be an aberration rather than a distinct form, but was taken in series. It tends strongly to lose its markings, especially on the hind wing beneath. One specimen from Irong-Roraima, Aug. 15, has the under side of the hind wing red-brown, practically without markings. One female from Kaieteur also is practically var. *evarete*. I think like *evarete* this is a transition form at the turn of the seasons, but it may turn out to be the wet form most closely corresponding to *arenosa*.

The third and southern group of forms reaches from near the southern boundary of Colombia on the west, and from the mouth of the Amazon on the east, south to the limit of the species. These forms may also be divided into a dark and a pale type, which appear from our present very limited knowledge to be rather forms of wet and dry areas than seasonal, but at the only place where I have seen a representative series from various months, Bolivia, both forms occur together with a partial sea-

sonal separation. They also occur together in Bahia and at Pará. I have also a single specimen of *hubneri* from the lower Amazon, where *pallens* (s.l.) is the normal form. The dark forms seem rather apt to lose the green tint from the hind wing, especially in the female, but such specimens usually differ from material of the central group in the deeper color of the tawny markings, and from all except form *vivida* and its transitions from the Uaupes region, by the well-developed tawny on the hind wing. The pale form shows practically the coloring of *genoveva*, but rarely loses the green; the male at least may be distinguished by the much more deeply concave outer margin of the fore wing (Holland, "Butterfly Book," Pl. 20, fig. 8), while the female is not far from the male of *genoveva*.

The oldest valid name for a member of this series seems to belong to a moderately pale form, *negra* Felder, which has page priority over the other Felder names except the unrecognizable *occidentalis*; but on account of its transitional character I have preferred the well-characterized name of *pallens*, from the same work. Felder distinguishes in all, four forms with this coloring, on locality and small differences of coloring. With the present material I cannot distinguish these, and am treating all as one form, ranging from Venezuela and the hills of Guiana to Argentine. By its description *infusata* Fld., seems distinct, but the specimens I have seen from Bahia are normal *negra* and *hubneri*.

J. l. pallens Felder. Ground clay color, more or less dusted and suffused with fuscous, with the disc of the hind wing strongly overlaid with green. Tawny spots of fore wing strongly outlined with blackish, and postmedian sinuate band contrasting. Fascia broad, clay-colored, more or less tinted with light tawny, broadly connected with the wide area about the lower eye-spot. Subterminal pale band of hind wing conspicuous, and tawny when the fascia of the fore wing is shaded with tawny. Under side of hind wing clay-color, the transverse markings generally fine and somewhat wavy, though as a rule less complex than in form *genoveva*. Postmedial region more or less shaded with red-brown; ocelli usually distinct, though a little blurred. Disc of fore wing more or less shaded with light tawny, especially below the cell. Type locality Venezuela.

The type material of *negra* seems to have been transitional, and is compared with "*lavinia*" (*hubneri*, *evarete* ♂ Hubner, Samml. figs. 1, 2) but is described as markedly paler than *hubneri*. It may really be a form approximating true *lavinia*, which seems to have been unknown to Felder, but I have matched it approximately with the darker specimens of this form from Manaos. Felder's second name, *hilaris*, from Paraguay, is compared with "*genoveva*" (apparently *oriana*, as Hubner's *evarete* ♀, figs. 3, 4 is cited), but the pale under side and green overlay indicate this form. A specimen in our collection from Jujuy, Argentina, may be considered equivalent. *Junonia pallens* Fld. from Venezuela and *J. divaricata* from Surinam are northern names, and may be represented by specimens from Zanderij and Kwakoe Gron, Surinam, and Mackenzie, Demerara. My specimens from these localities are broken, and may be migrants from a little farther south. Felder also gives Cuba as a locality for *divaricata*, but I have never seen a green specimen from the Antilles and suspect some confusion. Finally, *J. infusata* Fld. is said to be distinguished by the light brown fascia; it was described from Bahia, where the normal pale form is not unlike all from southern Guiana to Argentine. It may be an aberration.

J. l. hubneri Kirby (*evarete* Hubner, ♂, not Cramer, *lavinia* auct. in part, not Cramer). Ground blackish, deeper than most other forms, and much deeper than the *negra* series of forms; heavily overlaid with green. Fore wing with the fascia well marked, but wholly deep tawny (11'i, cinnamon rufous of Ridgway) much darker than in *incarnata*, and somewhat darker as a rule even than *vivida*; the fork across beyond the end of the cell about 2 mm. wide, as in *lavinia*, but the outer fork no darker, almost as conspicuous, preceded by the usual small white spots above the upper ocellus, and followed by a pale submarginal stripe. Lower ocellus in the original figure outlined with the tawny, but solidly in contact with the blackish base in normal specimens. Hind wing with a deep tawny submarginal fascia, followed by a conspicuously paler and duller marginal stripe. Fore wing beneath with the ground toward the base tawny as usual in dark forms, the two tawny bars in the cell concolorous with the ground about them, unlike the *genoveva-pallens* group;

fascia tawny, hardly paler than on the upper side, its outer fork gradually fading out into the light wood-brown ground of the apex. Hind wing wood-brown, heavily overlaid with fuscous, but with a reddish tint in the postmedial region. Ocelli well developed, but not contrasting in color.

This form, together with the next two, seems to cover the most habitable parts of South America. It is not clear whether there may not be an interruption of their distribution in the region of Jujuy, Argentina, where pale forms seem to occur alone. It runs far north on the east side of the Andes, to the R. Napo at least, but is replaced by a form of *zonalis* at Iquitos. My two most northern specimens, from Puerto Bermudez and the Rio Napo, have the lower ocellus of the fore wing wholly outlined with tawny, as in the type figure.

J. l. huacapistana new race.

Similar to *J. l. hübnéri*, but on the average a little smaller (43-49 mm.). Tawny area of the fore wing considerably extended, the inner fork of the fascia being over 3 mm. wide, and the whole fascia, measuring on M_3 , being about 6 mm. wide; ocelli larger, those of the hind wing with more conspicuous violet scaling. Under side more tawny, the tawny base and post-medial fascia being continuous.

Huacapistana, Rio Tarma, Peru, at about 8000 ft. June 1-2, 1920. Specimens from San Juan, in the Cerro de Sal, east of the Andes, at about 5000 feet, are substantially the same form, but typical *hubneri* occurs in the Chanchamayo valley, in between. C. U. type no. 893.

This form is an alpine variant of *hubneri*, occurring about at tree-line on the east side of the Andes. I am characterizing it in the hope that it may turn out a useful index-type in recognizing faunal zones.

J. l. lima new race.

Similar to *J. l. hubneri*, but smaller and darker, normally with brilliant green iridescence, but occasionally dull, especially in the female. Upper side almost wholly of the dark ground, with only a narrow submarginal band of brown, darker than in the other forms, and normally showing no tendency to surround the lower ocellus. Inner fork more or less completely and sometimes widely, separated from the rest of the band, appearing as a third

fascia parallel to the two in the cell. Ocelli about as in typical *hubneri*, smaller than usual in *huacapistana*, the upper one with white spots above it. Under side of fore wing mostly fuscous, though with the usual tawny base, and with the outer fascia reduced as on the upper side. Hind wing dull powdery fuscous, with less red-brown shading than the other forms, the ocelli obsolete. Expanse 40–50 mm. C. U. type no. 892.

This is the form from the west side of the Andes, at Lima, Peru. It was also taken at Chosica and Matucana. The smallest specimens were certainly dwarfed by lack of food, as they had eaten every scrap in the vicinity of Lima, but I believe that even when normal they would average smaller than *hubneri*. There is a good deal of variation in the amount of tawny above, and the hind wing may or may not have a submarginal band. The larva is similar to *coenia*.

Geographical Synopsis

United States: *Coenia* only.

Northern Mexico (Sinaloa and Durango): *coenia*, *zonalis* and transitionals. One specimen from Sinaloa approaching *constricta*.

Mexico City: *coenia* (a specimen of *hubneri* probably mislabeled).

Central America: *zonalis* and *genoveva* (a specimen of *hubneri* probably mislabeled).

Panama: *zonalis* and transition to *constricta*.

Bahamas: *coenia* (Nassau); *zonalis* (Inagua).

Cuba: *zonalis* and *constricta* (intergrading); *coenia* (not intergrading).

Isle of Pines: *coenia*; *constricta* (*zonalis* not seen).

Jamaica: *zonalis*, occasional *genoveva*, one transition to *constricta*.

Hayti to St. Thomas: *zonalis* with very large ocelli; *genoveva*. St. Croix, St. Kitts, Antigua, Guadeloupe, St. Lucia, Dominica: *zonalis* only, in Dominica mainly of form *incarnata*.

Barbadoes, Grenada: *genoveva* only.

Trinidad: *zonalis* and *genoveva*, partly at least seasonal.

Curaçao: *zonalis* and *lavinia*.

Colombia: *zonalis* and *constricta*.

Venezuela: *genoveva* and *pallens*, both without locality data and presumably from different districts.

Coast of Guiana: *oriana*, *genoveva* and transitions; *lavinia*, type only.

Barrens of Guiana: *arenosa*, *vivida*, *nigralis*, with strays of *oriana*, and transitions, and *pallens*.

Hill country of Guiana: presumably *pallens*.

Western Ecuador: *basifusca*.

Eastern Ecuador (R. Napo): *hubneri*.

Upper Amazon (Iquitos): *zonalis*.

Upper Amazon (R. Uaupes): transitions to *vivida*.

Middle and lower Amazon: *pallens* (*hubneri* occasional at Pará, and *genoveva* seen with a label of northern Pará).

West side of Peru: *lima*.

Temperate Peru (east of Andes): *huacapistana*.

Subtropical Peru: *hubneri*.

Bolivia: *hubneri* and *pallens*.

Bahia: *hubneri* and *pallens* (type loc. of *infuscata*).

Minas, Matto Grosso (Corumbá), Rio and Uruguay: *hubneri*.

Paraguay: *pallens* (Felder).

Jujuy, Argentina: *pallens*.

Upper Cauca valley, Colombia: *vestina*.

Alpine Ecuador and Peru: *v. livia*.

Lake Titicaca and Tucuman: *vestina* forms.

KEY TO FORMS

1. Ocelli of hind wing in a tawny area, not surrounded by yellow and black rings (*vestina*).....2
1. Tawny band of hind wing touching outer side of ocelli only, or wholly beyond them, the ocellus itself with a yellow and then a black outer ring (*lavinia*) 3
2. Of normal size (toward 50 mm.); ocelli of hind wing black with blue centers**v. vestina**
2. Dwarfed; ocelli of hind wing blind, mere black spots.....**v. livia**
3. Ocellus of hind wing with a red crescent (reduced to a few mahogany scales in very dark suffused aberrations).....**coenia** 4
3. Ocellus of hind wing normally with blue or violet scaling, but without red6
4. Postmedial band cream white, conspicuous, all markings normal.
typical form
4. All markings suffused with black5
5. Surviving markings and especially rings of eye-spots, broad and suffused.....**ab. schraderei**

5. Surviving markings fine and clean-cut, the red ring of the eye-spot often nearly lost ab. **nigrosuffusa**

6. Disc of hind wing with metallic green overlay¹..... 7

¹This character frequently fails in single specimens especially along the border zone of central and southern forms. Dark forms that should have the green overlay always have the tawny markings of a deep tawny (Ridgway's cinnamon rufous) and can thus be recognized even without locality labels; most of them also have a tawny submarginal band on the hind wing which is also rare in central forms except *vivida*. In the pale phases southern (properly green) forms have strongly excavate outer margin of the fore wing, the excavation being 2 mm. deep in normal-sized specimens (Holland, Pl. 20, fig. 8), while the central types have an excavation only about half as deep (Holland, fig. 9); sex for sex the anal angle is also more extended in the southern race, but the difference is almost intangible in the female.

6. Disc of hind wing without metallic overlay.....10

7. Ground of upper side black-brown, of under side brown, with broad darker shading..... 8

7. Ground of upper side clay color, sometimes heavily shaded with fuscous, of under side mostly clay color..... **pallens**

8. Tawny markings of upper side dark, reduced, the portion at the end of the cell nearly or completely separated from the outer part of the fascia; hind wing beneath with ocelli obsolete..... **lima**

8. Tawny markings somewhat lighter, the fascia complete, Y-shaped; under side of hind wing with two small but well-marked ocelli..... 9

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9. Fascia 6 mm. wide, measured on M_3 **huacapistana**

10. Ground of upper side blackish, without a contrasting fascia, or only a little as a series of separate vague spots..... **nigralis**

10. Ground dark, obliterating the spots in the cell, the fascia contrastingly pale straw yellow..... **basifusca**

10. Both spots in cell and fascia conspicuous.....11

11. Dark forms: ground above fuscous, below considerably shaded with brown, and usually mainly brown, with a contrasting, nearly straight paler postmedian band, when paler with the markings tending to be rather even and in broad bands.....12

11. Pale forms: ground above usually more or less shaded with fuscous on a clay-colored base; under side straw color or clay color, with the markings fine, and wavy or confused, without any broad areas of darker color (in *arenosa* the upper side is usually dark, but the under side shows the characteristic pale ground and fine pattern).....18

12. Under-side of hind wing suffused with deep red- or black-brown, with markings obscure and ocelli absent.....13

12. Under side with conspicuous dark postmedial area, bearing well-marked ocelli14

13. Fascia broadly ringing the lower ocellus of fore wing, the part across the end of the cell hardly broader; subterminal band on hind wing normally also well-marked..... **constricta**
13. Lower ocellus not strongly separated from the dark base, the fascia across the apex on the other hand conspicuous, usually without subterminal tawny on hind wing..... **evarete**
14. Submarginal band of hind wing and Y-shaped fascia of fore wing both bright tawny and conspicuous..... **vidua**
14. Submarginal band of hind wing obscure, the markings of the fore wing flesh color or more or less white..... 15
15. Disc of hind wing conspicuously green, the fascia largely white and contrasting with the dark ground..... **lavinia**
15. Disc of hind wing with at most faint traces of green..... 16
16. Fascia across fore wing at end of cell broader, averaging 4 mm. broad. **zonalis** 17
16. Fascia much narrower, averaging 2 mm. broad..... **oriana**
17. Fascia almost evenly flesh color..... ab. **incarnata**
17. Fascia largely white, shaded with flesh or tawny..... **typical**
18. Small (under 40 mm.). Upper side dark, with contrasting narrow clay-colored fascia, generally cut into spots by dark veins, and at its widest, beyond the cell, not twice as wide as an interspace; the female only with a little tawny..... **arenosa**
18. Large. (over 45 mm.). Upper side lighter fuscous in male, often of a washed-out tawny color in female, the submarginal band of hind wing broad and tending to suffuse into the ground; fascia across fore wing at end of cell much broader, and usually shaded with tawny. **genoveva**¹

CHECK-LIST

- | | |
|------------------------------|-------------------------------|
| 1. vestina Felder | CENTRAL FORMS |
| a. <i>vestina</i> | |
| b. <i>livia</i> Staudinger | b. zonalis Felder |
| 2. lavinia Cramer | <i>genoveva</i> auct. nec Cr. |
| | form <i>constricta</i> Felder |
| | <i>occidentalis</i> Fld. in |
| | part |
| NORTHERN FORMS | c. lavinia Cramer |
| a. <i>coenia</i> Hübner | normal form <i>oriana</i> |
| ab. <i>nigrosuffusa</i> B. & | Kirby |
| McD. <i>negra</i> auct. | <i>evarete</i> ♀ Hbn. nec Cr. |
| nec Fld. | |
| ab. <i>schraderi</i> Gunder | |

¹ In *J. infuscata* of Felder no mention is made of green overlay; I have assumed it will show the characteristic wing-form of other southern forms, even if the green is really absent; it should be distinguishable from either *pallens* or *genoveva* by the light brown fascia.

- genoveva* Fld. nec Cr.
 ab. *evarete* Cr.
 form *genoveva* Cramer
lavinia auct.
- d. *basifusca* Weymer
- e. *arenosa* Forbes
 form *vivida* Forbes
 ab. *nigralis* Forbes
- SOUTHERN FORMS
- f. *hubneri* Kirby
lavinia Fld. nec Cr.
- evarete* Hbn. ♂ nec Cr.
 form *pallens* Fld.
lavinia Holland nec
 Cr.
negra Fld.?
occidentalis Fld.
 in part
hilaris Fld.
divaricata Fld.
 ab. ? *infusata* Fld.
- g. *lima* Forbes
- h. *huacapistana* Forbes



FORBES: DISTRIBUTION OF FORMS OF *JUNONIA LAVINIA*.